B. P. I.—1130. Issued December 14, 1914.

United States Department of Agriculture,
BUREAU OF PLANT INDUSTRY,
Crop Acclimatization and Adaptation Investigations,
WASHINGTON, D. C.

SINGLE-STALK COTTON CULTURE.

By O. F. Cook, *Bionomist in Charge.*

The fact that the cotton plant has two distinct kinds of branches is the basis of a new system of cotton culture. By taking account

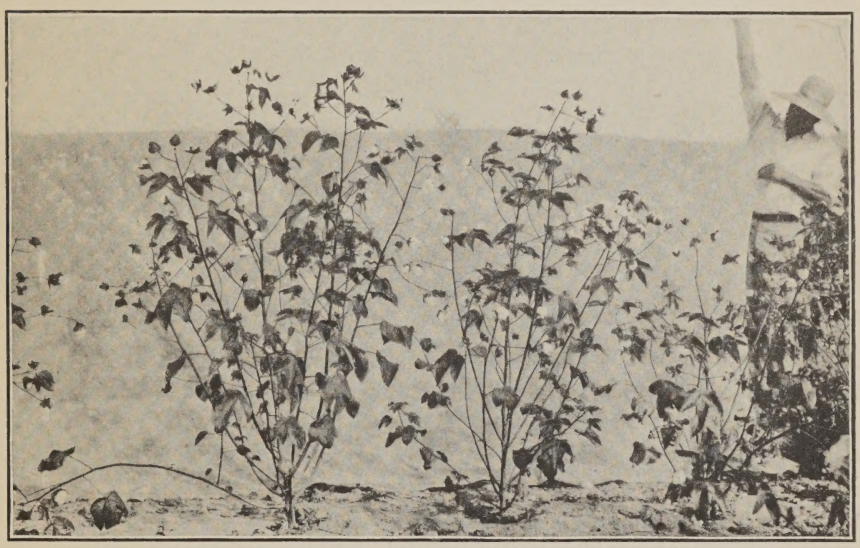

FIG. 1.—Egyptian cotton at Bard, Cal., in 1911, showing plants of medium size with the usual development of vegetative branches induced by early thinning. In addition to the central stalk, each plant had about 10 vegetative branches, or secondary stalks, the larger of these bearing fruiting branches like the main stalk. The photograph was taken at the end of the season after many of the leaves had fallen. Note that scarcely any fruit was produced below the middle of these plants. Compare with figures 2 and 3, and especially with figure 4, which shows single-stalk plants produced by the new system.

of the specialized habits of branching, it is possible to exercise a much more effective control of the development of the plants, so as to secure earlier crops, larger yields, and greater protection against injury by the boll weevil. The primary object in controlling the growth of the plants is to suppress the vegetative branches that spring from the lower joints of the central stalk. The suppression of the vegetative branches avoids the injurious crowding of the plants and injurious competition between the two kinds of branches. The vegetative branches do not produce flowers and bolls, but represent

additional stalks. If the season is long enough, the vegetative branches produce fruiting branches of their own, like the main stalk, but they do not assist in the production of an early crop and often interfere with earliness. In the Tropics, where the wild cottons grow as perennial shrubs or small trees, large vegetative branches have useful functions, but when cotton is being cultivated as an annual crop plant vegetative branches are undesirable.

The cultural ideal under the new system is a cotton plant with only the single erect central stalk, bearing numerous well-developed fruiting branches, but none of the vegetative branches, or secondary stalks. The old system produced spreading, bushy plants with

FIG. 2.—Egyptian cotton at Bard, Cal., in 1911, showing the same plants as in figure 1, but with the vegetative branches cut off and set up between the main stalks, to give a concrete idea of the extent of crowding represented by the production of numerous vegetative branches. This suggested that it was possible to grow single-stalk plants close together in the rows and yet have less crowding than with widely spaced large plants and numerous vegetative branches.

numerous vegetative branches that often filled the space between the rows and smothered the lower fruiting branches. The new system produces narrow, upright plants with only the horizontal fruiting branches projecting on each side and leaves an open space between the rows, thus permitting a much better development of the lower fruiting branches, those that produce the early bolls.[1]

[1] The botanical observations and agricultural experiments that have led to the development of the new system have been described in several publications of the Bureau of Plant Industry, United States Department of Agriculture, as follows:

Dimorphic Branches in Tropical Crop Plants: Cotton, Coffee, Cacao, the Central American Rubber Tree, and the Banana. Bulletin 198, 1911.

Morphology of Cotton Branches. Circular 109, p. 11–16, 1913.

A New System of Cotton Culture. Circular 115, p. 15–22, 1913.

The Abortion of Fruiting Branches in Cotton. Circular 118, p. 11–16, 1913.

A New System of Cotton Culture and Its Application. Farmers' Bulletin 601, 1914.

The suppression of the vegetative branches is easily accomplished by leaving the young plants close together in the rows. Thinning is deferred until the plants are from 6 to 12 inches high, instead of being done when the plants are only 2 to 4 inches high, as has been customary in the past. If the young plants stand less than 6 inches apart during these early stages of growth, most of them will not produce any vegetative branches, but will have only the upright central stalk and the horizontal fruiting branches.

Injury can be done, of course, by too much crowding in the early stages or by too much delay in thinning, but these dangers can be avoided by proper care. If the seedlings average less than 2 inches apart in the rows, the excess can be removed by a preliminary early

FIG. 3.—Egyptian cotton at Bard, Cal., in 1911, showing plants like those in figure 1, but with the vegetative branches cut off and the main stalks set up in the ground to illustrate the spacing required to produce the same quantity of cotton at the same rate as on the plants shown in figure 1 without the assistance of vegetative branches. The stalks were about 13 inches apart, the distance being determined by counting the bolls produced by main stalks and vegetative branches.

thinning. Thinning too late is injurious, because it interferes with the growth of the fruiting branches and thus reduces the yield instead of increasing it. The final thinning should not be deferred longer than is necessary to secure a suppression of the vegetative branches. Any further checking of growth is to be avoided. Attempts at applying the new system without a clear appreciation of the underlying principles that determine the formation of the branches are likely to result in failure. Farmers are advised to try preliminary experiments in order to learn how to use the new system before applying it to the crop as a whole.

The distance between the plants is regulated with reference to local conditions and the habits of growth of different varieties, the range being between 6 inches and a foot. With the vegetative

branches suppressed, the plants have a narrow, upright form and can be left closer together in the rows. Even with the plants only 3 or 4 inches apart in the rows there may be less injurious crowding than with large, many-stalked plants 3 feet apart in the rows. With rank-growing, large-leaved varieties the plants can not be left as close together as with varieties of more slender form or more open foliage. The final distance needs to be greater under conditions of luxuriant growth than where growth is restricted by adverse conditions of soil or climate. The more luxuriant the growth, the greater the necessity of preventing the formation of the vegetative branches, but

FIG. 4.—Egyptian cotton at Bard, Cal., in 1912, showing plants grown by the improved method, which almost entirely suppressed the vegetative branches. Note the close similarity of these single-stalk plants to the central stalks of large plants shown in figure 3. In comparison with figures 1 and 2, note that the lower fruiting branches have developed and produced an early crop. These plants were only about 1 foot apart, but could have been left still closer together without injurious crowding. If the usual method of thinning had been applied, the plants would have resembled those shown in figure 1, and even at 3 feet apart would have suffered from crowding because of the numerous vegetative branches that would have been produced.

after this has been accomplished the spacing is to be determined by other considerations.

The distance between the rows can also be varied with reference to local conditions. The narrower form of the plants makes it possible to bring the rows as close as 3 feet, but this increases the danger of injury if drought comes early in the season. In dry regions it is better to limit the number of plants by having the rows farther apart than by having the plants widely separated in the rows and allowing the vegetative branches to develop. The desirability of suppressing the vegetative branches was first appreciated in cultural experiments

FIG. 5.—Durango cotton plants at San Antonio, Tex., in adjoining rows. The left-hand row was thinned by the single-stalk system and showed an almost complete suppression of vegetative branches. The right-hand row was thinned early and showed the usual development of vegetative branches. There were nine open bolls on the right-hand plant and eight on the left-hand plant, but on account of the smaller size of these plants about twice as many of them could stand in the same space without injurious crowding.

FIG. 6.—Durango cotton at San Antonio, Tex., showing the same plants as in figure 7, with leaves removed to show the formation of the branches and the position of the bolls as affected by the different methods of thinning. The left-hand plant has one small vegetative branch, while the right-hand plant has four large vegetative branches and three small ones. The bolls of the left-hand plant are borne low down and close to the bases of the fruiting branches. On the right-hand plant most of the bolls are near the ends of the branches, which shows that they must have developed later in the season than those of the left-hand plant.

with the Egyptian cotton in California, along the lines illustrated in figures 1 to 4. On account of the greater tendency to luxuriance shown by the Egyptian cotton, the advantage of restricting the development of the vegetative branches is more strikingly obvious, though the same principle applies to the Upland type of cotton. (See figs. 5 to 12.)

Though the plants are more numerous under the new system, the number of stalks is greatly reduced. Thus, if we leave the plants 8 inches apart in the rows, there are three times as many plants as at 24 inches, but with each plant at 24 inches producing only 5 vegetative branches there would be twice as many stalks as with an 8-inch spacing of single-stalked plants. The three stalks, each pro-

FIG. 7.—Durango cotton at Norfolk, Va., showing the usual spreading form of Upland cotton plants when thinned early and allowed to produce vegetative branches. Rows of such plants were grown in alternation with others of the form shown in figure 8 for purposes of comparison, in order to determine the effects of the new system upon the Upland type of cotton grown under eastern conditions.

vided with its own root system, are much more efficient producers of cotton than the six or more stalks with one root system. When the number of branches is still further increased, so that each plant has ten or a dozen stalks, as often happens under conditions of luxuriance, there is no possibility of securing an early crop.

It has been supposed that earlier crops can be obtained by giving the young plants plenty of room, so that they can grow rapidly, but the effect is often to make the crop late, by inducing the young plants to throw out numerous vegetative branches. When the vegetative branches are very numerous they replace some of the fruiting branches; or, if normal fruiting branches begin to develop early in the season, they are overshaded and smothered out when vegetative branches

FIG. 8.—Durango cotton plants at Norfolk, Va., showing the complete suppression of the vegetative branches by the new method of thinning. These plants were grown in alternation with rows of the wide-spaced plants shown in figure 7. The rate of flowering, counted for 10 days in the early part of the season, showed an advantage of 42 per cent in favor of the single-stalk rows, and the average yield of the single-stalk rows was 53 per cent above that of the open-spaced rows.

FIG. 9.—Durango cotton at San Antonio, Tex., showing plants standing about 6 inches apart in the row. The leaves were removed to show the narrow, upright form assumed by plants when thinned late and left close together and the possibility of producing larger and earlier crops on single-stalked plants.

grow up around them. Thus, it becomes apparent that a very luxuriant growth of the young plants is not favorable to the production of an early crop, but has the contrary tendency to make the crop late. There can be no early crop unless the lower fruiting branches are allowed to develop. Suppression of the vegetative branches is a necessary precaution if early crops are to be secured under conditions of luxuriant growth.

The arrival of the boll weevil seemed to bring additional reasons for having the cotton plants farther apart. It became more important than ever to secure early crops, since late crops are usually destroyed by the weevils. Wider spacing also seemed necessary

FIG. 10.—Acala cotton at San Antonio, Tex., showing two single-stalk rows with a row of widely spaced plants between. The piles of seed cotton at the ends of the rows represent the first pickings. The cotton from the open-spaced row weighed 4 pounds and 2 ounces, while that of the close-spaced single-stalk rows weighed 10 pounds and 3 ounces in one case and exactly 10 pounds in the other. The experiment included 10 rows of each kind, the average increase of the single-stalk rows over the open-spaced rows being 84 per cent.

as a means of obtaining greater exposure for the fallen buds that contain the weevil larvæ, for if the infested buds are thoroughly heated and dried the larvæ are killed. But when closer attention is given to the facts, it becomes apparent that wider planting is not the most reliable way to secure an early crop in the presence of the boll weevil. The desired exposure of the soil is not assured by having the plants very far apart, because large plants with low, spreading branches soon keep the ground permanently shaded. Injurious crowding is more effectually prevented by suppressing the vegetative branches than by having the plants farther apart in the rows, and without the disadvantage of making the crop late.

Under the new system, the narrow, single-stalked plants stand well up from the ground, because the lower joints of the stalk are longer than when the plants are thinned too early, and the absence of vegetative branches leaves an open space between the rows, so that the sun can reach the fallen squares containing the weevil larvæ. The gathering of the fallen squares by hand is also facilitated, as well as the cultivation and harvesting of the crop. Pickers find their

FIG. 11.—Durango cotton at San Antonio, Tex., grown under irrigation, the plants being much larger than in the previous figures. Two plants are shown in a row that was thinned early to a distance of 2 feet and produced numerous vegetative branches. As the crop matured, most of the vegetative branches became prostrate, thus increasing the difficulty of picking the cotton and injuring the quality of the fiber.

movements impeded when the vegetative branches are large and fill the space between the rows. A part of the crop may be lost by the breaking down of the large vegetative branches, and if the bolls lie on the ground the fiber becomes soiled and mildewed. These difficulties interfered seriously with the establishment of the Egyptian-cotton industry in California and Arizona until the new system was adopted.

Another advantage of the new system is that the young plants usually grow more rapidly when they are left close together in the rows and thus secure mutual protection. Dry winds and blowing sands often injure or destroy young cotton after early thinning. The seedlings are delicate at first and are subject to a very widespread

FIG. 12.—Durango cotton at San Antonio, Tex., showing large single-stalk plants grown under irrigation in the next row to those shown in figure 11 and at the same distance apart, but later and more gradual thinning suppressed the vegetative branches. There being no vegetative branches to become prostrate it is much easier to pick the cotton, and none of the fiber is injured by the bolls lying on the ground. This experiment shows the extent to which the form of the plant can be controlled by the new method of thinning.

disorder known as leaf-cut, or tomosis, that greatly retards their development and often results in permanent stunting and deformity if the terminal bud is destroyed.[1] These dangers are lessened by leaving

[1] Cook, O. F. Leaf-Cut, or Tomosis, a Disorder of Cotton Seedlings. United States Department of Agriculture, Bureau of Plant Industry, Circular 120, p. 29–34, 1913.

the young plants closer together, and the deferred thinning makes it possible to remove weak and defective plants, whereas little or no choice can be exercised when the cotton is "chopped" too early. Throughout the season the single-stalk rows seem to suffer less from drought, and the leaves do not wilt as soon in dry weather. This would indicate that the root systems of the single-stalk plants are more efficient in supplying moisture or that the circulation is better. As these incidental advantages more than compensate for the somewhat greater care that is required in applying the improved method of thinning, the new system might be justified even apart from the main consideration of controlling the branches.

The general result of the new system is to secure an earlier production of flowers and bolls. When the new and old systems are compared by applying them to alternate rows, there are striking differences of behavior. The advantage is greatest, of course, under extreme conditions where the season of production is shortened by drought, early frost, or the ravages of the boll weevil. The rate of flowering of rows of single-stalk plants, as shown by daily counts early in the season, has been found to average far above that of the intervening rows of larger, many-stalked plants, the differences sometimes amounting to from 40 to 60 per cent. At the end of the season, correspondingly increased yields are obtained from the single-stalk rows, in some cases over 50 per cent. The potential value of such an application of botany to agriculture may be estimated at a high figure in a crop with an annual value of more than $600,000,000.

Approved:
K. F. Kellerman,
Acting Chief of Bureau.

September 28, 1914.

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
5 CENTS PER COPY

▽

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1914